

# Prospective Randomized Comparison Between Transperitoneal Laparoscopic Pyeloplasty and Retroperitoneoscopic Pyeloplasty for Primary Ureteropelvic Junction Obstruction

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## ABSTRACT

**Background and Objectives:** To compare laparoscopic transperitoneal versus retroperitoneoscopic pyeloplasty for primary ureteropelvic junction obstruction in a prospective randomized manner and assess overall results with long-term follow-up.

**Methods:** In this prospective study, from 2008 to 2012, 112 cases of primary ureteropelvic junction obstruction were randomized in a 1:1 ratio into 2 groups. Group I included patients who underwent transperitoneal laparoscopic pyeloplasty, and group II consisted of patients who underwent retroperitoneoscopic laparoscopic pyeloplasty. Demographic and clinical characteristics and postoperative and operative data were collected and analyzed. The statistical analysis was performed with the Fisher exact test,  $\chi^2$  test, and Mann-Whitney *U* test for independent groups, and  $P < .05$  was considered statistically significant.

**Results:** The total operative time and intracorporeal suturing time were significantly higher in group II than in group I ( $P < .001$ ). The visual analog scale score for pain on postoperative day 1 and the requirement for tramadol were significantly higher in group I than in group II ( $P = .004$ ). The hospital stay and the rate of temporary ileus were significantly greater ( $P < .036$  and  $P < .02$ , respectively) in group I than in group II. The success rate of transperitoneal laparoscopic pyeloplasty versus retroperitoneoscopic laparoscopic pyeloplasty was 96.4% versus

96.6% with a mean follow-up period of  $30.75 \pm 4.85$  months versus  $30.99 \pm 5.59$  months ( $P < .88$ ).

**Conclusion:** Transperitoneal laparoscopic pyeloplasty is associated with significantly greater postoperative pain, a higher tramadol dose, a higher rate of ileus, and a longer hospital stay in comparison with retroperitoneoscopic laparoscopic pyeloplasty. Although the operative time for retroperitoneoscopic laparoscopic pyeloplasty is significantly longer, the success rate remains the same for both procedures.

**Key Words:** Randomized, Transperitoneal, Retroperitoneal, Pyeloplasty, Primary ureteropelvic junction obstruction.

## INTRODUCTION

Laparoscopic pyeloplasty has emerged as the most common and widely accepted minimally invasive surgery for ureteropelvic junction obstruction (UPJO). This technique has advantages of a high success rate similar to open pyeloplasty and low morbidity similar to endopyelotomy.<sup>1-3</sup> Schuessler et al<sup>4</sup> were the first authors to report on transperitoneal laparoscopic dismembered pyeloplasty in 5 patients and concluded that the procedure, though time-consuming, was a feasible treatment option for UPJO. Janetschek et al<sup>5</sup> were the first authors to report on retroperitoneoscopic dismembered pyeloplasty and concluded that the procedure is too complicated to be a standard procedure. Since then, there have been many publications on both types of laparoscopic pyeloplasties, but the choice of whether to perform the procedure by the transperitoneal or retroperitoneoscopic route depends on the surgeon. In transperitoneal laparoscopic pyeloplasty (TPLP), the large peritoneal cavity allows for free movement of instruments and intracorporeal suturing, but the rate of bowel-related complications and pain are higher in comparison with retroperitoneoscopic laparoscopic pyeloplasty (RPLP).<sup>6-9</sup> In RPLP limited retroperitoneal space restricts free movement of instruments and leads to diffi-

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DOI: 10.4293/JSLS.2014.00366

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culty in intracorporeal suturing, leading to a longer operating time, but postoperative pain and the rate of bowel-related complications are comparatively lower.<sup>6,7,9,10</sup> Most of the published studies are either on TPLP or RPLP, and some have assessed a combination of both types with nonrandomized comparison and were retrospective in nature.<sup>7-9,11,12</sup> However, the success rate for both procedures is comparable.<sup>7-12</sup> Review of the literature shows only 1 prospective randomized study on the comparison of TPLP and RPLP for primary UPJO.<sup>13</sup>

In view of the excellent outcome results of both techniques in isolation with advantages and disadvantages of both procedures, we executed a prospective randomized trial of TPLP versus RPLP for primary UPJO, aiming to determine which technique is better with respect to success rate and postoperative pain and complications.

## MATERIALS AND METHODS

In this prospective randomized study, a total of 112 patients who underwent primary UPJO were included, from January 2008 to December 2012. Ethical approval was received in accordance with the Declaration of Helsinki. Clinical history and findings of general physical and abdominal examinations were recorded. Patients were examined by routine hemogram, renal function tests, liver

function tests, coagulation profile, urine culture, and sensitivity. We performed renal ultrasonography; intravenous urogram (IVU); contrast computed tomography (CT) scans of the kidney, ureter, and bladder; and diuretic renogram using <sup>99</sup>Tc-diethylenetriamine penta-acetic acid (DTPA) scans. For grading of hydronephrosis, we used Society for Fetal Urology universal criteria<sup>14</sup> (**Table 1**). From DTPA scans, split renal function and subrenal obstruction were documented. Spiral CT scans showed anterior crossing vessels at the ureteropelvic junction (UPJ) in 44 patients. Patients with a deranged coagulation profile, previous renal surgery, malrotated kidneys, huge hydronephrotic kidneys, or vertebral-spinal deformities were excluded from the study. After providing written informed consent, patients were randomized into 2 groups at a 1:1 ratio based on systematic random sampling. Group I consisted of TPLP patients, and group II comprised RPLP patients. With the patients under general anesthesia, cystoscopy and retrograde ureteropyelography were performed before surgery.

### Transperitoneal Laparoscopic Pyeloplasty

The patient was placed in the kidney position, carbon dioxide pneumoperitoneum created, and the procedure performed with 3 ports. The colon was reflected, the

**Table 1.**  
Comparison of Baseline Characteristics in TPLP and RPLP Groups

Parameter	Group I (n = 56)	Group II (n = 56)	P Value
Mean age (y)	24.79 ± 3.96	24.93 ± 3.94	.77
Sex ratio (male/female)	30:26	32:24	.77
Mean BMI <sup>a</sup> (kg/m <sup>2</sup> )	25.44 ± 3.49	26.83 ± 3.91	.15
Laterality (right/left)	26:30	25:31	.78
Mean serum creatinine level (mg/dl)	1.41 ± 0.49	1.43 ± 0.47	.58
Mean preoperative split renal function (%)	40.39 ± 2.92	41.96 ± 2.42	.76
ASA <sup>a</sup> score			
1	40	42	.83
2	16	14	.82
Grade of hydronephrosis			
II	18	16	.34
III	22	25	.84
IV	16	15	.83
Associated caliceal stones	4 of 56	6 of 56	.49
Anterior crossing vessels at UPJ	21 of 56	23 of 56	.59

<sup>a</sup>ASA = American Society of Anesthesiologists; BMI = body mass index.

ureter traced, and the UPJ dissected. Anterior crossing vessels were identified in 21 cases and were dissected to free them from the UPJ. The stenotic/aperistaltic segment of the ureter was excised, and the ureteric end was spatulated laterally for about 2.5 cm. Redundant pelvis was trimmed. Simultaneous removal of caliceal stones was performed in 4 cases. Ureteropelvic anastomosis was performed with No. 4-0 polyglactin as a continuous suture over a 6F/26-cm double-J stent. In patients with anterior crossing vessels, ureteropelvic anastomosis was performed in front of the vessels. After this, the rest of the pelvis was closed with continuous No. 4-0 polyglactin suture.

### Retroperitoneoscopic Laparoscopic Pyeloplasty

The patient was placed in the kidney position, and the retroperitoneal space was created by a combination of blunt finger and indigenous balloon dissection methods. The procedure was performed with 3 ports. The stenotic/aperistaltic ureteric segment was excised, the ureteric end was spatulated for about 2.5 cm, and a 6F/26-cm double-J stent was inserted. The redundant pelvic wall was trimmed. Ureteropelvic anastomosis was performed with No. 4-0 polyglactin as a continuous suture. Anterior crossing vessels were present in 23 cases. The ureteropelvic anastomosis was transposed and placed anterior to the anterior crossing vessels. The caliceal stones in 6 cases were removed by a grasper. In 1 patient there were multiple stones (20 stones), which were removed with a flexible cystoscope.

### Postoperative Care and Follow-Up

The tube drain was removed after 24 to 48 hours depending on the drain output. The visual analog scale (VAS) score for pain was determined on postoperative day 1 and day 2. A liquid diet was allowed once bowel sounds had returned, and the diet was increased gradually. Intravenous tramadol was given on patients' demand. The Foley catheter was removed on the second to third postoperative day, and the patient was discharged with advice of taking medications including suppressive antibiotic. The double-J stent was removed at 6 weeks. An IVU and DTPA scan were performed at 3 months. Patients were followed up annually with a DTPA scan. Patients who were symptomatic at follow-up were examined with renal ultrasonography, IVU, and DTPA scans. Patients with obstructed systems were counseled, and open pyeloplasty was performed. These patients were then followed up every 3 months, and DTPA scans were performed every 12 months. Immediate and long-term postoperative com-

plications were recorded using the modified Clavien grading system.

### Statistical Analysis

Statistical analysis was performed with SPSS software (version 16.0; SPSS, Chicago, Illinois) using the Fisher exact test,  $\chi^2$  test, and Mann-Whitney *U* test, and  $P < .05$  was considered statistically significant. Correlation among the different continuous variables was assessed by the Pearson correlation coefficient test. Correlation was considered strong if the correlation coefficient (*r*) was  $>0.5$  or  $<-0.5$ .

## RESULTS

A total of 112 patients were included, with 56 patients in group I (TPLP) and 56 patients in group II (RPLP). Open conversion was performed in 1 patient in the TPLP group and 2 patients in the RPLP group. The laparoscopic procedures were successfully completed in 109 patients: 55 in the TPLP group (98.2%) and 54 in the RPLP group (96.4%). The demographic characteristics of the patients were comparable in both groups (**Table 1**). Anterior crossing vessels were present in 44 cases (39.2%) (**Table 1**). Caliceal stones were present in 4 patients in group I and 6 patients in group II (**Table 1**). The differences in total operative time and intracorporeal suturing time were statistically significant between the 2 groups (**Table 2**). The VAS pain score was significantly higher and the requirement for tramadol on the first postoperative day and hospital stay were significantly greater in the TPLP group (**Table 2**). Postoperative complications (according to the modified Clavien grading system) were seen in 14.8% of patients (**Table 3**). Clavien grade I complications were seen in 3.6% of patients, grade II in 18%, and grade IIIb in 7.2%. Temporary ileus was seen in 10.8% of patients in the TPLP group ( $P < .027$ ) (**Table 3**). Secondary UPJO was observed in 2 patients in the TPLP group at a mean follow-up time of 7 months and in 2 patients in the RPLP group at 6 months; it was managed by open pyeloplasty, and postoperative DTPA scans at 3 and 12 months showed non-obstructive drainage. The mean follow-up period of patients was comparable in both groups (**Table 2**). The overall success rate was 96.4% for TPLP versus 96.6% for RPLP with a mean follow-up period of  $30.75 \pm 4.85$  months versus  $30.99 \pm 5.59$  months ( $P < .88$ ). The Pearson correlation coefficient for total operative time in RPLP patients with different demographic and operative parameters did not show any significant association.

**Table 2.**  
Comparison of Operative and Postoperative Results Between TPLP and RPLP Groups

Parameter	Group I (n = 56)	Group II (n = 56)	P Value
Mean total operating time (min)	162.14 ± 18.13	188.21 ± 24.05	.001
Mean intracorporeal suturing time (min)	67.07 ± 9.38	89.39 ± 6.78	.001
Mean VAS score on postoperative day 1	5.75 ± 0.65	5.29 ± 0.60	.004
Mean VAS score on postoperative day 2	2.57 ± 0.50	2.39 ± 0.50	.10
Mean tramadol dose on day 1 (mg)	179.17 ± 32.69	147.92 ± 34.52	.002
Mean tramadol dose on day 2 (mg)	93.75 ± 16.89	90.75 ± 24.72	.07
Mean hospital stay (d)	3.39 ± 0.28	3.14 ± 0.36	.036
Mean follow-up (mo)	30.75 ± 4.85	30.99 ± 5.59	.88
Mean postoperative split renal function at 3 mo (%)	48.89 ± 7.48	48.78 ± 8.61	.76

**Table 3.**  
Postoperative Modified Clavien Complications in TPLP and RPLP Groups

Complication	No. of Patients (%)		P Value
	Group I (n = 56)	Group II (n = 56)	
Clavien grade I			
Transient mild hematuria	1 (1.8)	—	>.99
Subcutaneous emphysema	—	1 (1.8)	>.99
Clavien grade II			
Temporary ileus	6 (10.8)	—	.02
Fever (UTI <sup>a</sup> )	1 (1.8)	1 (1.8)	>.99
Prolonged urine drainage	—	1 (1.8)	>.99
Port-site infection	1 (1.8)	—	>.99
Clavien grade IIIb			
Secondary UPJ obstruction	2 (3.6)	2 (3.6)	>.99

<sup>a</sup>UTI = urinary tract infection.

## DISCUSSION

Schuessler et al<sup>4</sup> were the first authors to describe TPLP for primary UPJO, in 1993. In 1996 Janetschek et al<sup>5</sup> reported RPLP for the same entity. Both of these techniques are now well established, with excellent success rates, and each has its own advantage and disadvantages.<sup>7–13</sup> In TPLP the peritoneal cavity is traversed, the colon is reflected, and reconstruction is then performed. There are risks of bowel injury, ileus, and peritoneal contamination by leaked urine, infection, and carbonic acid.<sup>6–9,15,16</sup> However, TPLP provides a larger peritoneal cavity for instrument handling and intracorporeal suturing. In RPLP there is minimal risk of bowel-related complications and contamination of the

peritoneal cavity. Retroperitoneoscopy allows a limited working space for instrument handling and intracorporeal suturing but provides direct access to the ureteropelvic regions.<sup>6,7,9,10</sup> In our study the total operative time and intracorporeal suturing time were significantly higher in the RPLP group. The longer operative time results from the limited working space and difficult instrument handling.<sup>10,11,13,15,17,18</sup> The difference in the VAS pain score on the first postoperative day, requirement for tramadol, and hospital stay were significantly higher in the TPLP group (**Table 2**). Relatively greater pain in TPLP patients is due to traversing of the peritoneal cavity, manipulation, and reflection of the colon, which requires more tramadol for pain management.

Anterior crossing vessels were present in 44 patients (39.2%), similar to findings previously reported in the literature.<sup>13,15,17–20</sup> In the TPLP group, the ureteropelvic reconstruction was performed anterior to the anterior crossing vessels, whereas in the RPLP group, it was performed behind the anterior crossing vessels, in a manner similar to the TPLP. Our technique was consistent with the basic principle of Andersen-Hynes open pyeloplasty in which transposition of the ureteropelvic anastomosis must be performed anterior to the anterior crossing vessels. The transposition is easy to perform in TPLP, but in RPLP this remains a concern. In our study we did not encounter difficulty in achieving this in RPLP, and routine transposition was performed. In retroperitoneoscopy the crossing vessels are easily and better seen with simple elevation of the lower pole of the kidney, and transposition and reconstruction are not difficult to perform.<sup>20,21</sup> In our study, in no cases of retroperitoneoscopy did we encounter any difficulty in performing the dismembered pyeloplasty in the presence of anterior crossing vessels. In fact, the crossing vessels—after dissection from the UPJ and disconnection of the ureter from the pelvis—undergo a cephalad shifting and do not impede the reconstructive procedure. The reconstructed ureteropelvic region, though lying anterior to the anterior crossing vessels, practically lies inferior to the vessels and hence does not create difficulty in performing anastomosis. The crossing vessels have been postulated to be involved in the etiopathogenesis of UPJ and to be an indicator of poor outcome after endopyelotomy.<sup>22,23</sup> In some studies on RPLP, the transposition was not routinely performed; rather, in selected cases, the vessels were dissected and placed cephalad to the UPJ, and ureteropelvic anastomosis was performed. The comparison of results with or without transposition did not show any difference in outcome. However, the selection of cases for not to transpose was not very clearly defined.<sup>9,17–20,24</sup>

A 70-fold increased risk of stones developing in primary UPJO has been reported by Husmann et al.<sup>25</sup> The increased risk is not because of obstruction leading to delayed washout of urinary solutes and infection; rather, metabolic abnormalities are the most accepted theory.<sup>22,25</sup> In our study caliceal stones were present in 4 patients in the TPLP group and 6 patients in the RPLP group. Concomitant stone extraction was performed successfully in all cases. In 1 patient with multiple stones (20 stones), a flexible cystoscope was inserted to remove some of the caliceal stones. Concomitant stone extractions with a flexible nephroscope and cystoscope have similarly been reported by other authors.<sup>8,13,17,26</sup>

The rate of postoperative complications in laparoscopic pyeloplasty patients ranges from 12.9% to 22.5%. The incidence in our study was 14.8%, which is comparable with the literature.<sup>6,8,10,13,16,21,27–29</sup> The important early complications are leakage of urine from the anastomotic site, infection, and bowel-related complications. Regarding delayed complications, secondary UPJO due to stenosis/stricture of the reconstructed ureteropelvic region is very important and influences the success rate of pyeloplasty. In TPLP temporary ileus could be due to bowel mobilization and manipulation. Ileus is a comparatively under-reported complication of transperitoneal laparoscopic surgery, and it must be recognized because it has postoperative implications in patient management.<sup>28</sup> In our study the rate of temporary ileus was significantly higher in the TPLP group; temporary ileus was also observed in some previous studies on TPLP.<sup>8,15</sup> Secondary UPJO was observed in 2 patients in each group. Contrast CT urogram should be the investigation of choice in such patients.<sup>15</sup> In our study CT urogram showed a mean stricture length of 2.2 cm with grade IV hydronephrosis in all patients. Open pyeloplasty was performed, and follow-up with DTPA scan showed nonobstructive drainage. Treatment of secondary UPJO after failed pyeloplasty can be performed by laparoscopic techniques. Endopyelotomy has also been advocated if the length of stricture is <2 cm.<sup>15,20,21,29,30</sup> The decision to perform open or laparoscopic pyeloplasty depends on the surgeon's judgment and radiologic findings. In our study the decision to perform open pyeloplasty was made because of the presence of a long stricture length and consent for open surgery.

The success rate for laparoscopic pyeloplasty ranges between 85% and 99%.<sup>7,8,10,11,13,17,18,20</sup> Success is assessed by both subjective and objective methods. The subjective assessment is based on clinical improvement, and the objective assessment is based on IVU (patency of UPJ with decrease/absence of hydronephrosis) and nonobstructed drainage on nuclear scans.<sup>10,13,17,18,20,26</sup> Success in our study was based on both subjective and objective assessment. Devenport et al,<sup>7</sup> in a retrospective analysis, reported a 92% success rate for TPLP versus 67% for RPLP. The drawbacks of their study were the small number of patients in the RPLP group, in whom transposition of the anterior crossing vessels was not performed, and the effect of the learning curve for retroperitoneoscopy in the initial study period. Inagaki et al,<sup>8</sup> in a retrospective study, reported a 95% overall success rate for TPLP, including both dismembered and non-dismembered pyeloplasty. Soulie et al<sup>10</sup> reported an 88.9% success rate for RPLP, but the main drawback of the study was assessment of success

based on excretory urography. Abuanz et al,<sup>11</sup> in a retrospective nonrandomized study, reported an 87% success rate for RPLP versus 82% for TPLP (85% overall success rate). The drawbacks of their study were the involvement of multiple surgeons, comparatively small sample size, and difficulty in controlling follow-up in some patients. The explanation for the comparatively lower success rate (85%) in this study was the comparatively longer follow-up period ( $48.93 \pm 38.94$  months), which might have altered the long-term success of the procedures. Shoma et al,<sup>13</sup> in a prospective randomized comparison between TPLP and RPLP, showed 95% and 90% success rates, respectively, with mean follow-up periods of 23 months and 20 months, respectively. The main drawback of their study was the small sample size. Eden et al,<sup>17</sup> in a prospective study, reported a 97.5% success rate for RPLP with a mean follow-up period of 19.7 months. Janetschek et al,<sup>20</sup> in an interesting study, reported a 98.5% success rate for Fenger-plasties at long-term follow-up.

In our study the success rate was 96.4% for TPLP versus 96.6% for RPLP with a mean follow-up period of  $30.75 \pm 4.85$  months versus  $30.99 \pm 5.59$  months ( $P < .88$ ). Follow-up in this study was performed with IVU and DTPA scans at 3 months and then by DTPA scans every 12 months. Our study is the first prospective randomized study that included a good sample size with long-term follow-up. All procedures were performed by a single urologist using 3 ports to allow a fair comparison of all postoperative parameters including pain. The VAS scoring was performed on the first and second postoperative days by a person who was blinded to the procedure type, and the complications were recorded using the modified Clavien grading system.

## CONCLUSION

Although the operative time is significantly higher for RPLP, TPLP is significantly associated with postoperative pain, requirement for tramadol, hospital stay, and ileus in comparison with RPLP. However, the success rate remains the same for both procedures.

## References:

- Bauer JJ, Bishoff JT, Moore RG, Chen RN, Iverson AJ, Kavoussi LR. Laparoscopic versus open pyeloplasty: assessment of objective and subjective outcome. *J Urol.* 1999;162:692–695.
- Klingler HC, Remzi M, Janetschek G, Marberger M. Comparison of open versus laparoscopic pyeloplasty technique in treatment of uretero-pelvic junction obstruction. *Eur Urol.* 2003;44:340–345.
- Baldwin DD, Dunbar JA, Wells N, McDougall EM. Single centre comparison of laparoscopic pyeloplasty, Acucise endopyelotomy, and open pyeloplasty. *J Endourol.* 2003;17:155–160.
- Schuessler WW, Grune MT, Tecuanhuey LV, Preminger GM. Laparoscopic dismembered pyeloplasty. *J Urol.* 1993;150:1795–1799.
- Janetschek G, Peschel R, Altarac S, Bartsch G. Laparoscopic and retroperitoneoscopic repair of ureteropelvic junction obstruction. *Urology.* 1996;47(3):311–316.
- Rassweiler JJ, Teber D, Frede T. Complications of laparoscopic pyeloplasty. *World J Urol.* 2008;26:539–547.
- Devenport K, Minervini A, Timoney FX Jr. Our experience with retroperitoneal and transperitoneal laparoscopic pyeloplasty for pelvi-ureteric junction obstruction. *Eur Urol.* 2005;48(6):973–977.
- Inagaki T, Rha KH, Ong AM, Kavoussi LR, Jarrett TW. Laparoscopic pyeloplasty: current status. *BJU Int.* 2005;95(Suppl 2):102–105.
- Adeyoju AB, Hrouda D, Gill IS. Laparoscopic pyeloplasty: the first decade. *BJU Int.* 2004;94:264–267.
- Soulie M, Salomon L, Patard JJ, et al. Extraperitoneal laparoscopic pyeloplasty: a multicentric study of 55 procedures. *J Urol.* 2001;166(1):48–50.
- Abuanz S, Game X, Roche J-B, et al. Laparoscopic pyeloplasty: comparison between retroperitoneoscopic and transperitoneal approach. *Urology.* 2010;76(4):877–881.
- Wagner S, Greco F, Inferrera A, et al. Laparoscopic dismembered pyeloplasty: technique and results in 105 patients. *World J Urol.* 2010;28:615–618.
- Shoma AM, El Nahas AR, Bazeed MA. Laparoscopic pyeloplasty: a prospective randomized comparison between the transperitoneal approach and retroperitoneoscopy. *J Urol.* 2007;178:2020–2024.
- Reddy PP, Mandell J. Prenatal diagnosis: therapeutic implications. *Urol Clin North Am.* 1998;25:171–180.
- Chen RN, Moore RG, Kavoussi LR. Laparoscopic pyeloplasty. Indications, technique, and long-term outcome. *Urol Clin North Am.* 1998;25(2):323–330.
- Graefen M. The modified Clavien system: a plea for a standardized reporting system for surgical complications. *Eur Urol.* 2010;57:387–389.
- Eden C, Gianduzzo T, Chang C, Thiruchelvam N, Jones A. Extraperitoneal laparoscopic pyeloplasty for primary and secondary ureteropelvic junction obstruction. *J Urol.* 2004;172(6):2308–2311.
- Eden CG, Cahill D, Allen JD. Laparoscopic dismembered pyeloplasty: 50 consecutive cases. *BJU Int.* 2001;88(6):526–531.

19. Boylu U, Oommen M, Lee BR, Thomas R. Ureteropelvic junction obstruction secondary to crossing vessels—to transpose or not? The robotic experience. *J Urol.* 2009;181:1751–1755.
20. Janetschek G, Peschel R, Franscher F. Laparoscopic pyeloplasty. *Urol Clin North Am.* 2000;27:695–698.
21. Moon DA, El-Shazly MA, Chang CM, Gianduzzo TR, Eden CG. Laparoscopic pyeloplasty: evaluation of a new gold standard. *Urology.* 2006;67:932–936.
22. Stern JM, Park S, Anderson JK, Landman J, Pearle M, Cadeddu JA. Functional assessment of crossing vessels as etiology of ureteropelvic junction obstruction. *Urology.* 2007;69:1022–1024.
23. Von Cangh PJ, Nesa S. Endopyelotomy. Prognostic factors and patient selection. *Urol Clin North Am.* 1998;25:281–288.
24. Bachmann A, Ruszat R, Forster T, et al. Retroperitoneoscopic pyeloplasty for ureteropelvic junction obstruction (UPJO): solving the technical difficulties. *Eur Urol.* 2006;49:264–272.
25. Husmann DA, Milliner DS, Segura JW. Ureteropelvic junction obstruction with a simultaneous renal calculus: long term followup. *J Urol.* 1995;153:1399–1402.
26. Ramakumar S, Lancini V, Chan DY, Parsons JK, Kavoussi LR, Jarrett TW. Laparoscopic pyeloplasty with concomitant pyelolithotomy. *J Urol.* 2002;167(3):1378–1380.
27. Lin YH, Chung HJ, Lin AT, et al. Complications of pure transperitoneal laparoscopic surgery in urology: the Paipai Veterans General Hospital experience. *J Chin Med Assoc.* 2007;70:481–485.
28. Singh V, Sinha RJ, Gupta DK, Kumar M, Akhtar A. Transperitoneal laparoscopic ureterolithotomy versus retroperitoneal laparoscopic ureterolithotomy: a prospective randomized comparison study. *J Urol.* 2013;189:940–945.
29. Murphy D, Challacombe B, Rane A. Laparoscopic reconstructive urology. *J Minim Access Surg.* 2005;1(4):181–187.
30. Lee DI, Clayman RV. Management of secondary ureteropelvic junction obstruction in the adult. *Atlas Urol Clin.* 2003;11:205–219.